

CHAPTER 5 QUALITY ASSURANCE REQUIREMENTS

5-1. Responsibility. The contractor/depot quality assurance activity is responsible for the performance of the inspections specified herein. The contractor/depot may use its own facilities or any other commercial laboratory acceptable to the Procuring activity or Commodity Manager (PA/CM). The PA/CM reserves the right to perform any of the inspections specified herein when such inspections are necessary to assure that supplies or services conform to the prescribed requirements.

5-2. Quality Assurance Terms and Definitions. The quality assurance terms and definitions used herein are in accordance with Quality Management System Requirements, ISO 9001:2000, 13 Dec 2000.

5-3. Inspection and Test Equipment.

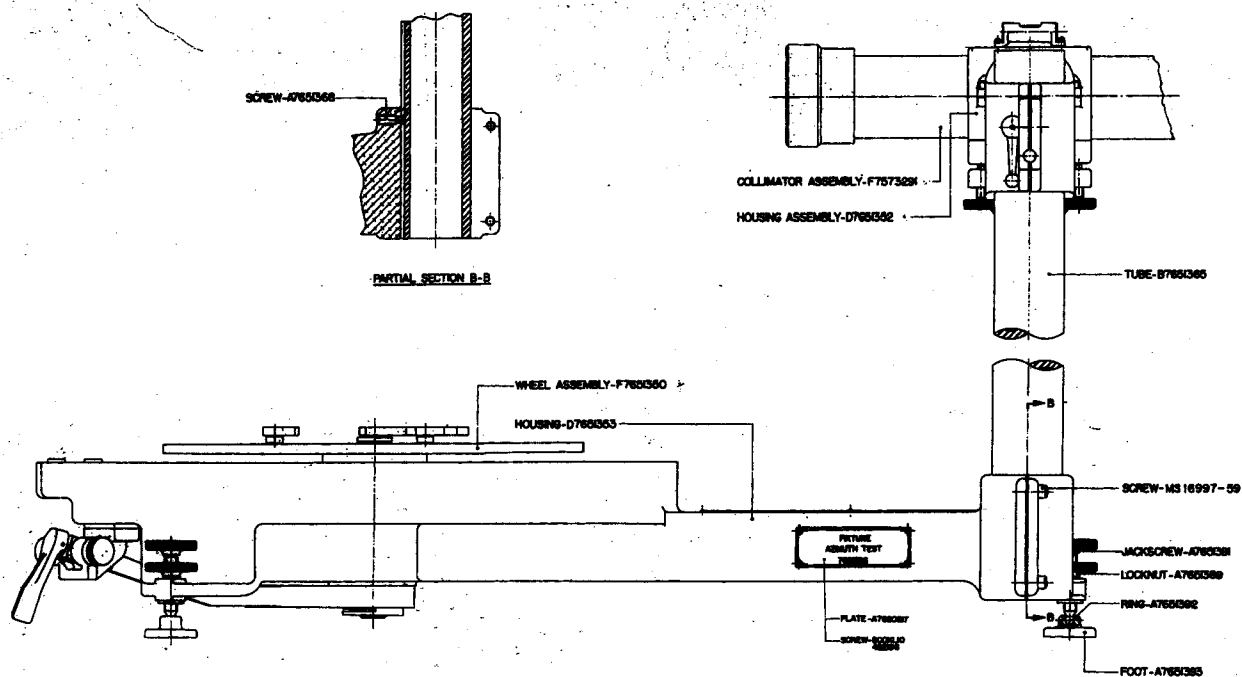
a. Responsibility. Unless otherwise specified, the contractor/depot shall be responsible for the acquisition, maintenance, calibration, and disposition of acceptance, inspection, and test equipment used in conjunction with this program. Inspection test equipment shall be controlled in accordance with the requirements of Quality Management System Requirements, ISO 9001:2000, 13 Dec 2000, tailored by excluding paragraph 7.3

b. Design Requirements.

(1) Orientation. The special testing equipment to position and test the elevation and azimuth accuracy of the aiming circle shall conform to the following:

(a) Azimuth test fixture	7691596
(b) Collimator projector	7573291
(c) Aperture	7659826
(d) Adapter, telescope – rear	7659829
(e) Adapter, tool class A	7659830
(f) Adapter, telescope - f r o n t	7659831
(g) Collimator attachment	7659832
(h) Dioptrimeter	7680631
(i) Magnetic needle tester	7681312
(j) Wall target	7681321
(k) Test, fixture, aiming circle	7687113
(l) Magnetic alignment fixture	7694427
(m) Adapter, aiming circle	8298207
(n) Dovetail snap gage	10549885

(2) Wall target. A wall target shall be used to measure the elevation accuracy of the aiming circle. The target shall be made as specified in paragraph 5-3b (l)(j) and set up as illustrated in figure 5-1.



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F765356, SHY 3		TEST FIXTURE, AZIMUTH	
REV	DESCRIPTION	DATE	BY
1	INITIAL DESIGN	10/1/54	W. J. HARRIS
2	REVISED TO ADD DETAIL	10/1/54	W. J. HARRIS
3	REVISED TO ADD DETAIL	10/1/54	W. J. HARRIS
4	REVISED TO ADD DETAIL	10/1/54	W. J. HARRIS
5	REVISED TO ADD DETAIL	10/1/54	W. J. HARRIS
6	REVISED TO ADD DETAIL	10/1/54	W. J. HARRIS
7	REVISED TO ADD DETAIL	10/1/54	W. J. HARRIS
8	REVISED TO ADD DETAIL	10/1/54	W. J. HARRIS
9	REVISED TO ADD DETAIL	10/1/54	W. J. HARRIS
10	REVISED TO ADD DETAIL	10/1/54	W. J. HARRIS

(3) Azimuth accuracy. Use the test equipment specified in paragraph 5-3b(I) (a), (b) (g), (k), and (m) in performing the azimuth accuracy tests. Position the azimuth test fixture on a stable platform and cross-level it using a 10 second level. With the aid of an alignment telescope, set the target collimator so that the optical axis is aligned to the pivotal axis of the wheel assembly of the fixture. The height of the collimator shall be such that the entire objective of the aiming circle telescope is visible through the collimator.

(4) Elevation accuracy. The test equipment specified in paragraph 5-3b(1)(a), (j), and (m) shall be used in performing elevation travel and accuracy tests. The tests will be performed on the same equipment used for the azimuth accuracy tests with the addition of a calibrated wall target.

(5) Magnetic compass accuracy. The test equipment specified in paragraph 5-3b(1)(b), (i), (j), and (1) shall be used in performing magnetic needle setting and accuracy tests. Set up the fixture in a north-south direction. Cross level the mounting surface for the aiming circle under test using a 10-second level. Set up and auto collimate the target collimator in the vertical axis.

(6) Telescope accuracy. The test equipment specified in paragraph 5-3b(1)(b)(e), (h), and (j) shall be used in performing telescope accuracy and resolution tests. The target collimated shall be auto-collimated using the mirror assembly of the test fixture. For resolution set a target at a distance determined by the setup instructions drawing for the resolution test target.

(7) Torque requirements. The torque wrench type tester for testing knobs shall have a range of zero to 10 inch-pounds, graduated in inch-ounces. The accuracy of the torque wrench type tester shall be five percent throughout its excursion range. The testing equipment shall use adapters suitable to the knob under test.

(8) Fabrication, setup, and calibration. Design and fabrication of test equipment shall incorporate the features of rigidity, stability, and ease of maintenance and use. Setup and calibration equipment necessary for certification of the testing equipment accuracy shall be furnished and will become a part of the testing equipment.

5-4. Certification of Personnel, Materials, and Processes. The contractor/depot QA activity shall be responsible for ascertaining and certifying personnel skills, equipment, and materiel meet the requirements of the work to be accomplished. Unless otherwise specified by the contract or PA/CM representative, the contractor/depot QA activity shall provide the PA/CM with statements or other evidence that specifications for such specified processes as welding, radiography, plating, and the like have been complied with.

5-5. Quality Plan. The contractor shall prepare a quality plan covering the rebuild or overhaul for this item in accordance with Quality Management System Requirements, ISO 9001:2000, 13 Dec 2000, tailored by excluding paragraph 7.3 as directed by the contract. Depots should also prepare a quality plan per the same requirement.

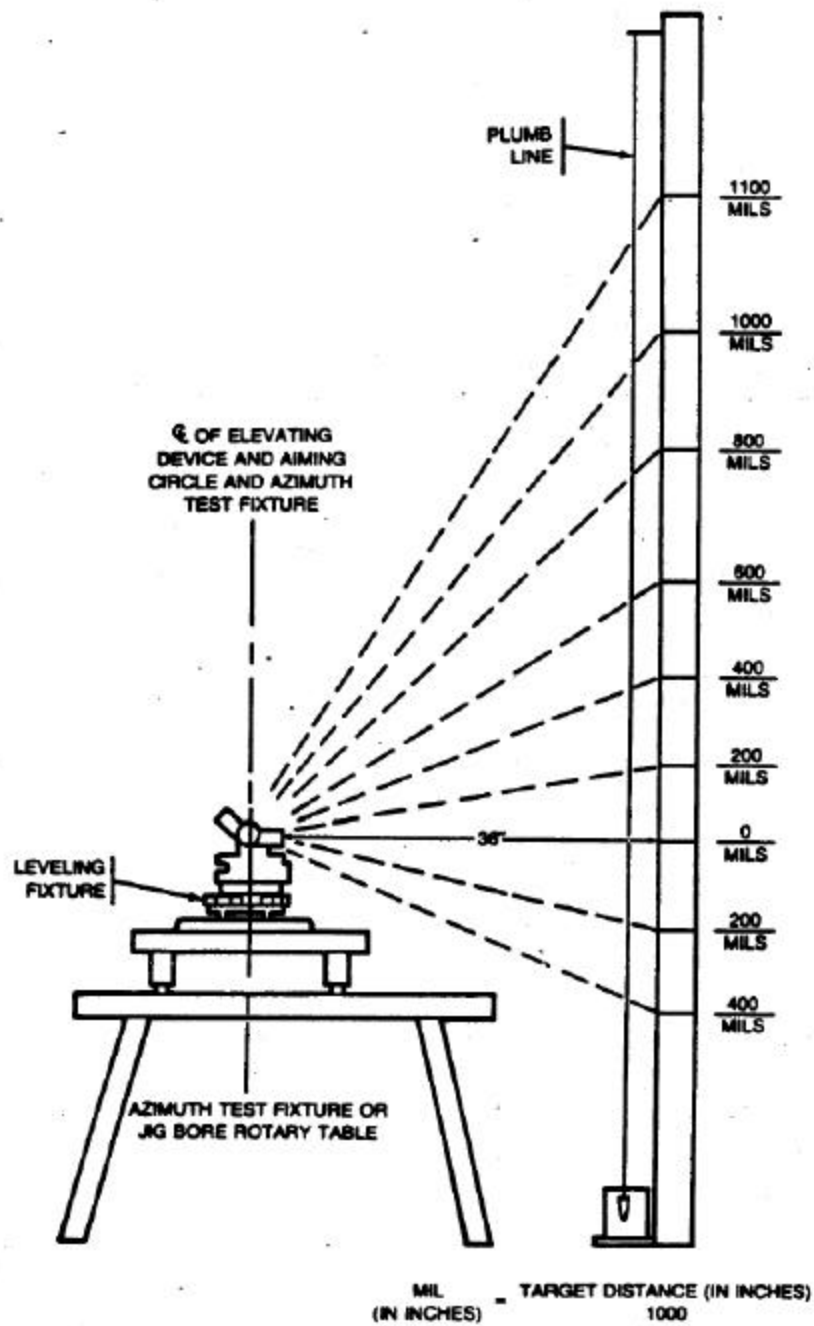


Figure 5-1. Layout of test fixture and targets

Figure 5-1. Layout of Test Fixture and Targets

Section II. INSPECTION REQUIREMENTS

5-6. First Article Inspection/Comparison Test. The requirement for first article inspection/comparison test is not applicable unless it is specified in the ordering document, such as, work directives or contract. When first article test is specified, the samples shall consist of three (3) items. The samples shall be rebuilt/overhauled or repaired in the same manner as used in regular rebuild/overhaul or repair programs. If required by the procuring activity, a product comparison test shall be performed in accordance with the requirements specified in the contract.

5-7. In-Process Inspection.

a. Disassembly.

(1) The overhaul inspection procedures (OIPs) are placed in this DMWR at various stages of disassembly. The purpose of the OIP is to provide depot/contractor personnel with inspection criteria on certain selected parts and subassemblies which are considered unique and important to the functional aspects of the end item. The inspection criteria referenced in the OIP contains only those dimensions and characteristics considered essential to satisfy the design in tent of that part or subassembly.

(2) The OIP does not direct the amount of disassembly nor does it dictate the extent of disassembly to perform an adequate overhaul. Rather, the OIP specifies inspection characteristics, based upon sound experience and judgment, which will require inspection as the result of prescribed disassembly determinations made by the depot/contractor during the planning phase of the overhaul program.

(3) During in-process inspection, the replacement of gaskets, seals, cotter pins, dowel pins, and locking wires is mandatory. All common hardware such as nuts; bolts, screws, washers, etc., will be inspected and reclaimed or replaced if damaged in any way. In instances where an item in the rebuild, overhaul, or repair program is not covered by an OIP, the applicable Quality Assurance Provisions of MIL-F-13926 shall apply.

b. Assembly. Tests and examinations specified in chapter 4 shall be performed during the course of repair and reassembly. Final inspection or acceptance inspection shall be as specified in paragraph 5-8.

c. Contractor Testing. When the contractor is responsible for conducting first article tests, the sample shall be inspected by the contractor for all the requirements of the contract. The record of this inspection shall include actual obtained results and data discovered during the inspections and tests where numerical values are obtainable. All certificates of conformance for all replacement parts used in the rebuilt, overhauled, or repaired item, shall be maintained for Government review. The Government reserves the right to witness the contractor's inspection.

5-8. Acceptance Inspection.

a. Inspection Provisions.

(1) Submission of product. Unless otherwise specified by the contracting officer, inspection lot size, lot formation, and presentation of lots shall be in accordance with "Submission of Product" provisions of MIL-STD-1916.

(2) Final acceptance inspection. Subsequent to first article approval, examination and tests specified herein shall be performed on a single defect (Individual characteristic) basis in accordance with MIL-STD-1916 and the sampling plans specified herein. Sampling for the list of characteristics shall be in accordance with level II of MIL-STD-1916 except as otherwise indicated. The following characteristics shall constitute the minimum inspection to be performed by the supplier after first article approval and prior to Government acceptance or rejection by item or lot.

(3) Acceptance inspection following depot overhaul will be performed 100%.

(4) Acceptance and rejection. Screen rejected lots for all defective characteristics. Removal or correction of defective units and re-submittance of rejected lots shall be in accordance with "Acceptance and Rejection" as specified in MIL-STD-1916.

(5) Acceptance and rejection at depots will be based upon 100% inspection and defective units will be re-inspected 100%.

Table 5-1. Final Inspection Sheet (Performance Characteristic)

Item: Aiming Circle M2/M2A2

Serial No. _____

Performance Characteristic

Critical: None

Major:

Class	Characteristic	Accept	Reject
101	Vibration Para 5-8d (1)		
102.	Cleanliness of telescope Para 5-8c(2)		
103.	Cleanliness of magnifier Para 5-8c(2)		
104.	Azimuth scale setting Para 5-8c(4)		
105.	Elevation scale setting Para 5-8c(5)		
106.	Centrality, tubular level vial bubbles Para 5-8c(7)(a)		
107.	Eccentricity, circular level vial bubble Para 5-8c(7)(b) 5-5		
Class	Characteristic	Accept	Reject
108.	Eyepiece focus Para 5-8c(6)		
109.	Orienting mechanism Para 5-8c(8)		
111.	Parallelsism of reticle and image Para 5-8c (9)		
112.	Plumb travel Para 5-8c(10)		
113.	Elevation limits Para 5-8c (11)		
114.	Backlash, Elevating mechanism Para 5-8c (12)		
115.	Elevation error Para 5-8c(13)		
116.	Backlash-elevating mechanism Para 5-8c(14)(a)		
117.	Backlash-upper azimuth mechanism Para 5-8c (14)(b)		

- 118. Backlash-orienting mechanism Para 5-8c(14)(c)
- 119. Lift Para 5-8c(16)
- 120. Side play Para 5-8c(17)
- 121. Total horizontal error Para 5-8c(18)
- 122. Compass-magnetic needle Para 5-8c(19)(a)
- 123. Compass-half period Para 5-8c(19)(c)
- 124. Magnifier assembly parallax Para 5-8c(20)
- 125. Magnetic needle magnifier Para 5-8c(21)
- 126. Open sight Para 5-8c(22)
- 127. Parallax-telescope Para 5-8c(23)
- 128. Magnetic needle, clamp, and release mechanism Para 5-8c(24)
- 129. Illumination Para 5-8c(26)

Minor: None

NOTE

The tests in table 5-1 shall be conducted at a temperature between +60°F and +90°F.

Checked By: _____ Date: _____
 Inspected By: _____ Date: _____

b. Special Sampling for Environmental Testing.

(1) Samples shall be selected from lots at random using inspection requirements of MIL-STD-1916. The samples shall have met all the requirements and tests outlined in table 5-1 prior to being subjected to the examination and test listed in table 5-2.

(2) Should any one item of a special sample fail to meet the specified test requirements, acceptance of the represented inspection lot will be suspended by the government until necessary corrections have been made by the contractor and the resubmitted samples have been approved.

Table 5-2. Final Inspection Sheet (Environmental Testing)

Item: _____ Serial No. _____

No.	Characteristic	Accept	Reject
307.	Sealing, telescope Para 5-8c(3)(a) (60" t o 90" F)		
308.	Sealing, compass compartment Para 5-8c(3)(a) (60" t o 90' F)		
309	Sealing, complete instrument Para 5-8c(3)(b) (60" t o 90" F)		
401	Alignment Para 5-8c(15)		
402.	Repeatability Para 5-8c(19)(b) (60" t o 90" P)		

Checked By: _____ Date : _____
 Inspected By: _____ Date : _____

C. Test Methods and Procedures.

(1) Vibration. The aiming circle shall withstand a vibration of 30 + 5 hertz frequency with an amplitude of 1/16 inch (1/8 inch total excursion) for a period of 2 minutes + 15 seconds. The aiming circle, with the magnetic needle in the locked position, shall be subjected to the vibration test using standard vibrating equipment capable of meeting the conditions above. The accuracy of the applicable test equipment and test equipment measurements shall be in accordance with "Test Facilities" requirements of MIL-F-13926. Mount the aiming circle in its normal operating position on the vibrating table by means of an adapter. Vibrate the aiming circle in a vertical plane with the motion and frequency applied for the time period specified. At the conclusion of this vibration, subject the aiming circle to a visual and tactile examination for damage (such as bent or broken parts, glass chips, fractures, foreign matter, and cement separation) and to a functional examination of moving parts for undue irregularities of movement, friction, or looseness. Any one of the aforementioned defects shall be cause to consider an aiming circle defective unless separate defects-per-hundred type sampling plans are established or approved by the Government as part of the supplier's inspection system. Aiming circles that have passed the above examinations shall be subjected to the tests in paragraph 5-8c(2) to paragraph 5-8c(26).

(2) Cleanliness. Inspect the optical surfaces of the telescope and the magnifier for cleanliness in accordance with paragraph 3-6d. The telescope reticle and the magnifier reticle shall not contain particles of dirt in excess of the amount specified in paragraph 3-6d. Inspection of the optical components and assemblies for dirt particles is required by means of a Scratch and Dig Standard conforming to Drawing C7641866. The telescope and magnifier shall conform to the respective cleanliness requirements. Perform this test subsequent to vibration test.

(3) Sealing.

(a) Telescope and compass compartment. Test telescope and compass compartment seals using special testing equipment conforming to the one station pressure tester, Drawing F7660400 or two station-pressure tester, Drawing F8565556. A special hose adapter to pressurize the telescope and compass compartment will be required. The procedure for the internal pressure test described in the setup and operating instructions on the applicable drawing shall apply. The telescope and compass compartment shall each be pressurized with a dry nitrogen gas to the required pressure and maintained for the time specified. The telescope will not show a pressure drop of more than 1 PSI for a period of at least 2 minutes.

(b) Complete instrument. Perform sealing test for the complete instrument using both special testing equipment conforming to the one station-pressure tester, Drawing F7660400 or two station-pressure tester, Drawing F8565556 and an adapter conforming to pressure test adapter, Drawing F7681313, to receive the complete instrument. The procedure for the external pressure test described in the setup and operating instructions and the applicable drawing shall apply. The sealed instrument within the test adapter shall be pressurized with dry, nitrogen gas to the required pressure and maintained for the time specified. Leakage, as indicated on the gage of the test equipment, shall not be evident

within the time period specified for sealing.

(4) Azimuth setting. With the axis of the two azimuth worms approximately parallel to each other and on the same side of the vertical axis of the instrument and with the index line set to coincide with the zero graduation line on the azimuth scale, the azimuth micrometer shall indicate zero. Inspect using special testing equipment. The test equipment shall consist of the devices depicted on Drawing F7681321, Final Test Instruction Sheet and List of Drawings. Mount the aiming circle on the special testing equipment according to the setup instructions described on Drawing F7681321. Azimuth scale setting is a visual test that shall be made to verify the zero reading of the micrometer.

(5) Elevation setting. With the telescope level, as indicated by the tubular level vial, coincide the zero graduations on both the telescope elevation scale and the micrometer knob scale with the respective index lines within 1/4 line width. Mount the aiming circle on the special testing equipment according to the setup instructions, Drawing F7681321. *Test elevation scale setting visually to check the elevation scale and micrometer knob scale with their respective indexes to conform with the requirement above.

(6) Eyepiece focus. Perform the eyepiece focus test with a dioptometer conforming to Drawing F7680631. Adjust the dioptometer by setting the slide scale index to zero and the eyepiece of the dioptometer to the best focus on the dioptometer reticle. Place the dioptometer at the eyepiece of the telescope on the aiming circle. Adjust the dioptometer, by movement of the dioptometer tube, until the telescope reticle appears in sharp focus. The diopter scale on the tube of the dioptometer shall indicate between the -0.75 (3/4) and -1.0 diopter.

(7) Leveling. Mount the aiming circle according to the setup instructions, Drawing F7681321. Make sure the telescope line of sight describes a horizontal plane within 0.1 mil as the upper azimuth knob rotates the telescope 360 degrees. Make sure these requirements are met:

(a) Tubular level vial bubbles. The tubular level vial bubbles shall be central with respect to the level vial graduations within 0.15 mil and shall agree with each other within 0.15 mil.

(b) Circular level vial bubble. Eccentricity of the bubble, with respect to the red circle on the face of the circular level vial, shall not exceed one-half the width of the line forming the red circle.

(8) Orienting mechanism. The line of sight shall not deviate from the horizontal by more than 0.3 mil when rotated 360 degrees in azimuth by the orienting (lower azimuth) knob. To inspect the aiming circle take readings of at least eight random settings from the position established in paragraph 5-8c(7) through the 6400 mils of travel in azimuth. Use lower azimuth knob and the index table "B" of the special testing equipment to counter-rotate the aiming circle. Observe the horizontal target zero through the telescope for deviation from zero on collimator "G" of the special testing equipment.

(9) Parallelism of reticle and image. With the aiming circle in the level position at zero elevation, proceed to make the check by sighting through the telescope. Coincide one end of the telescope's vertical reticle line with the image of a vertical target line when the setting of "80" graduation of the elevation graduation scale is aligned with the index. Then observe coincidence at the opposite end of the reticle line. The vertical reticle line of the telescope shall not deviate from the image of the vertical target line by more than the 0.60 mils as measured on the calibrated target. Deviation can be measured with the index table vernier scale "R" of the special testing equipment.

(10) Plumb travel. The line of sight shall not deviate from a plumb line by more than 0.40 mils when the telescope is actuated through 430 mils depression to 830 mils elevation movement at any azimuth setting. Start with the reticle line end plumb line in coincidence at zero elevation. An additional plumb travel error of 0.6 mils is permitted for the M2A2 in the elevation range from 830 to 1100 mils. With the vertical line of the telescope reticle superimposed on a plumb line, the line of sight shall track the plumb line through elevation and depression as directed and within the limit specified above. Move the vertical line of sight with the elevation knob. Deviation can be measured with the index table vernier scale "R" of the special testing equipment, and shall be noted.

(11) Elevation limits. The stop rings shall allow at least 830 mils movement limit of the telescope above the horizontal for the M2 Aiming Circle and at least 1130 mils movement limit of the telescope above the horizontal for the M2A2 Aiming Circle. On the M2 and M2A2 Aiming Circles, they shall allow 430 mils movement limit below the horizontal and shall prevent the telescope from striking the compass box cover. Coincident with paragraph 5-8c(10), bring the telescope line of sight, scales, and micrometers to zero. Rotate the elevation micrometer knob to the limit above and below the horizontal permitted by the stop rings. The stop rings should prevent the aiming circle telescope from striking the housing cover in the depressed position. Observe the limit of movement, pertinent to the requirements above, by means of the elevation marks on a target calculated in accordance with the target formulas described in the setup instruction sheet, Drawing F7681321.

(12) Circle error (azimuth). Take at least eight random settings throughout the 6400 mils of rotation with the aiming circle positioned in the special testing equipment and leveled. Set the upper azimuth knob to zero by clockwise rotation of the aiming circle. Set Index Table "B" of the special testing equipment to zero. Use the lower azimuth knob to direct the line of sight of the telescope to center on the collimator reticle. All scales and micrometers of the aiming circle will set to zero. Offset the index table an amount equal to a whole mil in a clockwise direction. Rotate the upper azimuth knob to the same whole mil mark on the micrometer, with the aiming circle revolving in a counterclockwise direction, using the microscope micrometer "W" to align the aiming circle's upper azimuth index and micrometer scale graduation. Read azimuth error by observing the amount of movement required in the index table micrometer scale "R" to re-center the telescope reticle with the collimator reticle. Note the reading. Continue to offset the test fixture an amount equal to a whole mil at a time and re-center the telescope reticle back on the collimator reticle until the fixture is back on zero. At each setting, note the reading. Error in any reading shall not exceed the limit of 0.70 mil, excluding backlash.

(13) Elevation error. With the aiming circle positioned in a horizontal plane in coincidence with target zero, check elevation error by setting mil readings on the elevation micrometer corresponding to elevation target stops. Zero should be set with deflection or elevation of the line of sight opposed to the direction of motion required by the target in order to include backlash. Any deviation of the telescope line of sight from the horizontal zero shall not exceed the limit specified in paragraph 3.2, and 3.3.7 MIL-A-13338E. Take readings in increments of 200 mils above and below the horizontal.

(14) Backlash.

(a) Elevating mechanism. Test backlash of the elevation mechanism by measuring angles as indicated in paragraph 5-8c(13). Adjust the instrument's line of sight so that its horizontal reticle line is superimposed on the horizontal target line. Elevate the line of sight by rotating the elevation micrometer knob until reaching a selected point on the target. Note reading of the elevation micrometer scale. Continue rotation, in the same direction, to a stop beyond this selected point on the target, and then reverse the direction of rotation until the line of sight is superimposed on the same selected point on the target without over travel. Note reading on the micrometer scale. The difference of the readings is the amount of backlash. Backlash for the mechanism shall not exceed the tolerance of 0.70 mil.

(b) Upper azimuth mechanism. With the aiming circle set up in the special testing equipment as in the above tests, adjust the instrument's line of sight so that its vertical reticle line is superimposed on the vertical target line. Rotate the azimuth knob about 600 mils away from the vertical target line and then rotate the knob in the opposite direction until the vertical reticle line of the telescope is again superimposed on the vertical target line. Note the reading of the azimuth micrometer scale. Continue rotating the aiming circle in the same direction, about 300 mils, and then reverse the direction of rotation until the vertical reticle line of the telescope is superimposed on the same vertical target line without over travel. Again note the reading of the micrometer scale. The difference of the two readings is the total amount of backlash. Backlash for the mechanism shall not exceed the tolerance of 0.40 mil.

(c) Orienting mechanism. Test backlash in the orienting mechanism in the same way as in paragraph 5-8c(14)b. Turn the aiming circle telescope in azimuth until its line of sight is directed away from the vertical target line by a few revolutions of the orienting knobs. Then rotate the orienting knobs in the opposite direction until the vertical reticle line of the telescope is superimposed on the vertical target line. Note the reading on the scale of the special testing device. Continue rotating the aiming circle in the same direction by a few revolutions of the orienting knobs, and then reverse the direction. Turn back the orienting knobs the same number of revolutions and stop the movement when the same reading is reached on the scale of the special testing equipment. The amount of backlash can be determined by observing the distance between the vertical reticle line of the telescope and the vertical target line. Backlash for the mechanism shall not exceed the tolerance of 0.70 mil.

NOTE

If over travel occurs during the operations described under paragraph 5-8c(14), the test shall be nullified and the procedures specified for backlash shall again be performed.

(15) Alignment. Use special testing equipment conforming to Drawing 7694427(1) to do this test. After the equipment and the aiming circle are set up in accordance with the setup and alignment procedures indicated on Sheet 7 of Drawing F764427, apply the following procedure. . With transformer knob "K" of the power supply "M" in zero position, turn switch "La to the ON position; lamp "J" will be illuminated. Release needle clamp "I" on the aiming circle. Rotate transformer knob "K" clockwise until the direct current (dc) meter "H" reads 90 volts. Using the elevation and orienting knobs on the aiming circle, coincide the crosshairs of the telescope with the crosshairs of the collimator reticle while viewing through aperture "G." View through aperture "F" and center the needle index on the magnifier reticle by orienting knobs of the aiming circle. With needle index centered on the magnifier reticle, sight through aperture "G" on the telescope and ascertain if the vertical crosshair of the telescope is within the tolerance of 0.50 mil. Return needle clamp "I" to the locked position.

(16) Lift. With the aiming circle mounted on the special testing equipment and leveled, adjust the line of sight so t h a t the horizontal reticle line is superimposed on the horizontal target line. Deflect the azimuth motion of the instrument one-quarter revolution past its starting point while sighting through the telescope, and then reverse the direction of rotation by means of the upper azimuth worm knob. Repeat this procedure a minimum of four deflection settings equally spaced f o r a minimum of one revolution of the instrument in azimuth. Perform this test using the lower azimuth worm knob. Note any vertical displacement of the line of sight with respect to the horizontal target line, as a result of reversing azimuth motion by means of either azimuth worm knob. The tolerance shall not exceed 0.40 mil.

(17) Side play. Perform this test in sequence to the test in paragraph 5-8c(16). Adjust the line of sight **so** that the vertical reticle line is superimposed on the vertical target line. Rotate the elevation knob through its full excursion while sighting through the telescope and then reverse t h e direction of rotation by means of the elevation knob. Note any horizontal movement of the line of sight with respect to the vertical target line. The tolerance shall not exceed 0.30 mil.

(18) Total horizontal error. Inspect for the total horizontal error in the arithmetic sum of errors for paragraphs 5-8c(10), 5-8c(12), and 5-8c(17) as described therein. The tolerance shall not exceed 1.5 mil under any conditions.

(19) Compass.

(a) Magnetic needle. Use special testing equipment conforming to Drawing F7681312 in performing the test for the requirements of paragraph 3.2.3.7.2 MIL-A-1338E. Place identical spacer between the tilt table (part 5 of the special testing equipment) and the table stop ring (part 6 of the equipment) so that the table will not tilt. Level the table by means of a precision bench level. Mount the aiming circle on the tilt

table and adjust the instrument until the level bubbles remain centered. Rotate the table, with spacers removed, or aiming circle until the compass needle is oriented in the north-south direction. With the compass needle unlocked and the end of the needle aligned with its line on the compass reticle, as viewed through the magnifier, do the 3-degree functional test by depressing the tilt table against the stop ring in any position required.

(b) Repeatability. With the aiming circle leveled and the compass needle oriented in the north-south direction, unlock the needle and, while sighting through the magnetic needle magnifier, align the end of the needle with the edge of a reticle line. Magnetically deflect the needle to a maximum displacement in both directions and visually check for repeat readings which shall not exceed the tolerance of .50 mil (the approximate width of a vertical line). Perform this test for all instruments at standard ambient temperature.

(c) Half period. In areas where the horizontal intensity of the earth's magnetic field is not lower than 0.12 oersteds, the average half period shall be 2.5 seconds or less for a minimum of six successive half periods when the needle is deflected a minimum of 8 degrees. The half period is the time interval between successive transits of the south end of the needle through its point of equilibrium. Measure the average half period time with a standard stopwatch for the requirements above. If the average half period time is excessive, examine the compass for magnetism of the needle and finish of the pivot point and jewel. In cases where no cause for defects is apparent, test for measurement of the earth's magnetic field in terms of minimum oersteds required above.

(20) Magnifier assembly parallax. With the magnetic needle reticle line located at near coincidence with the index of the magnetic needle, the inspector's head is moved from side to side while observing the lines of the reticle and needle through the magnifier assembly. Any apparent movement is considered parallax and shall not exceed the tolerance of 1 mil. (One reticle line width is equivalent to approximately 0.15 mil.)

(21) Magnetic needle magnifier. To help do this test, direct a light in to the housing cover window over the needle reticle and damper. Inspect the focus of the magnifier at the surface, of the needle by means of a dioptrimeter (see paragraph 5-8c(6) adjusted to your eye. Direct the line of sight to the dioptrimeter in to the magnifier. Adjust the dioptrimeter, by movement of the dioptrimeter tube, for the sharpest view of the magnetic needle etching. The reading on the diopter scale on the tube, indicating error in terms of diopters, shall be within 0 to -0.5 diopter.

(22) Open sight. Check the open sight with the same setup employed for the test in paragraph 5-8c(8). With the telescope focused on the target's line of sight mark, the open sight shall read within the limits of the circle on the target described in the setup instruction, Drawing P7681321. The line of sight of the open sight shall be parallel to the line of sight of the telescope within 20 mils.

(23) Parallax in telescope. Parallax between reticle and target image shall be nominally zero at 50 yards and shall not exceed 0.30 mil over a range of 30 to 150 yards. With the aiming circle mounted on the special testing equipment and leveled, check parallax. Sight through the ocular of the telescope and observe a point of coincidence on a target adjusted to the distances specified above with respect to a corresponding point of

the telescope's reticle in close proximity to the telescope's optical axis. With the target image adjusted to the 50 yard range, parallax between the reticle and target image shall be parallax free as viewed through the eyepiece assembly of the telescope. The target shall contain lines subtending 0.3 mils right and left, up and down from the original coincidence setting. Parallax will be recognized as any apparent displacement of the target's image in relation to the reticle image when the observer's head is moved from side to side or up and down. Any apparent movement of the target image shall not exceed the target tolerance lines at the distance specified above.

(24) Magnetic needle, clamp, and release mechanism. The clamping mechanism shall function to hold the magnetic needle finally against the compass box cover when the lever is vertical. When rotated clockwise to the horizontal position, the lever must detent and cause the needle to swing free. When rotated counterclockwise to the farthest position, the lever shall free the needle while under finger pressure. When released, spring action shall return the lever to the vertical position, causing the needle to be held firmly against the compass box cover. This is a visual and tactile test.

(25) Torque. Test running torque with a torque wrench type tester that measures in ounce inches and be equipped with an adapter to accommodate testing of the respective knobs. Rotate the torque wrench in a clockwise and then in a counterclockwise direction. Take readings when the knob is in continuous motion throughout its range of movement. The measured values shall not exceed the limits specified below:

	+60 °F	+90°F
	<u>Max</u>	<u>Min</u>
Elevation knob	28	12
Upper azimuth knob	36	12
Orienting azimuth knobs	48	24
Leveling knobs	68	32

(26) Illumination. The aiming circle shall meet the "Illuminated reticles " requirement of paragraph 3-6d. With the telescope reticle illuminated, the reticle markings shall appear clearly defined when observed in a darkened area. The illumination test is a visual check and shall be conducted in accordance with paragraph 3-6d. Illuminate the reticle with the lighting instrument energized with a 3-volt source.